TROPICAL TYPHUS IN A TRAINING CAMP.

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An investigation of the continued fevers of the Federated Malay States has shown that typhus occurs in a sporadic form from one end of the country to the other. It differs essentially from the ordinary type by reason of its lack of infectivity. It does not pass direct from one person to another and there is no evidence that it is carried by lice.

Megaw (1921) has drawn attention to a sporadic and localized form of typhus in the Kumaon district of the Himalayas, which he considers is probably carried by ticks. Yersin and Vassal saw non-infectious cases in Indo-China during 1908. Smith investigated a similar outbreak in the sugar-cane fields of Queensland in 1910. In 1922, Maxy and Havers saw thirteen cases of the same kind of fever, with a positive Weil-Felix reaction, in Alabama. There was no evidence of louse infestation in these cases. In 1923, Hone reported the occurrence of a typhus-like disease in and around Adelaide. The Weil-Felix reaction was positive and the disease resembled typhus in every way except that it did not spread from man to man and there was no evidence that it was carried by lice. In February, 1925, Megaw, Shettle and Roy described an outbreak of typhus-like fever among a body of 2,000 soldiers in Central India. The men, who were engaged in manoeuvres, were living in two camps situated in a country covered with jungle and uncultivated scrub. Though the condition of the camp was favourable to direct infection from person to person there was no evidence that it occurred, and when a man fell sick he did not infect his fellows who shared the same tent. Lice were excluded as vectors, and Megaw, who incriminates ticks, suggests that it should be called "tick-typhus." It attacks persons leading an open-air life, camping or marching in the jungle or scrub, and in this respect it resembles the tsutsugamushi of Japan and the spotted fever of the Rocky Mountains. The Weil-Felix reaction was negative in Megaw's cases, but possibly the Bacillus proteus culture was at fault; no mention of positive control tests is made in his report.

The typhus of the Malay States resembles these sporadic forms very closely and we call it "tropical typhus" because it appears to be more common in the tropics than the epidemic form; we do not mean to imply that it occurs nowhere else. It is necessary to distinguish it by some name; to call it simply "typhus" is to mislead and alarm the public who, though they may be quite ignorant of everything else about typhus, know that it is highly infectious and may spread like wild-fire.

Kuala Lumpur, the capital of Federated Malay States, is only four
degrees north of the Equator; the mean temperature is about 84° F. and there is no appreciable seasonal variation. Typhus had not been recognized in the country before August, 1924. In the following eight months, twenty-six cases were diagnosed in different parts of the peninsula; in most cases by the examination of a blood specimen which had been sent to the laboratory because the patient had typhoid symptoms.

In the autumn of 1924 a military training camp was formed just outside the mining village of Sungei Besi, nine miles from Kuala Lumpur. It was occupied by some six hundred men belonging to a British regiment which was stationed in Singapore. An advance party came up on September 10, but the main body did not arrive until a fortnight later. Five cases of typhus occurred between the ninth and the sixteenth of October and a sixth case on November 7, a week after the regiment had returned to Singapore. There was no evidence that the disease had been introduced into Sungei Besi by the soldiers. No cases had occurred in Singapore where they came from, but there had been at least four cases in the Malay States, shortly before their arrival. We examined the blood of twenty-three healthy men in the regiment, as controls, including those who had served in the Near East during the war, but none of them gave a positive Weil-Felix reaction. There was no question of the men having become infected on the journey from Singapore, because they had travelled, not only by different trains, but on different days. Several of them had never left the camp from the time of their arrival to the day on which they were taken ill, and one must conclude that they became infected within its precincts.

The general features of the disease were similar to those of typhus in other parts of the world. Only two of the men were seriously ill, the others had very mild attacks and all of them recovered. Before the true nature of the disease was disclosed by the Weil-Felix reaction, two of the patients had been notified to the Health Department as cases of typhoid fever, two had been treated for malaria, one had been diagnosed as influenza and one as bronchitis.

The incubation was as short as twelve days in one instance; Corporal H., the fifth case, arrived in the camp on October 1, and was taken ill on the twelfth.

The onset was sudden, with headache, chills, pains in the limbs and injection of the conjunctivæ, like influenza. The disease developed rapidly, and by the end of the first week the two severe cases were in a busy, muttering delirium, like men in the third week of an attack of typhoid fever. Only one of them had a really profuse rash; in the remainder, it was either evanescent or inconspicuous. Other symptoms were a general enlargement of the lymphatic glands in two, splenic enlargement in one, loss of knee-jerks in two, deafness in one and bronchitis in three. The respirations were increased to over thirty in three patients, and one was much troubled by meteorism. The temperature was remittent; it reached
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its height on the eighth or ninth day and came down to normal, by rapid lysis, between the twelfth and fifteenth days, except in one instance where it was prolonged by broncho-pneumonia.

The Weil-Felix action was positive in all and was highest during convalescence, towards the end of the third week. In three cases, the maximum titre was between 1,000 and 3,000; in the other three, it was more than 7,000. We employed, for this test, an emulsion of living organisms (given to us by Dr. A. N. Kingsbury) which had been obtained from the Lister Institute in 1921. A dilution of 1 in 200 was taken as the limit above which the reaction was regarded as positive. Repeated tests were made in each case and the evidence of a waxing and waning titre, obtained in this way, was cogent proof of active disease.

Control tests were made with the blood of 365 people; some of these were healthy but the majority were hospital patients, with various ailments, whose blood was sent to the laboratory for Widal's reaction. Eighteen cases of typhoid fever were included and all gave negative Weil-Felix reactions. B. proteus X 19 was not agglutinated at a titre above 1 in 30, in 359 cases; it was agglutinated at 1 in 60, in 4; and at 1 in 120, in 2. There was some evidence that the last two cases had suffered from typhus.

Marris's atropine test for typhoid fever was applied in two cases; in one, on the fifteenth day of illness, and in the other, on the eighth day. The result was negative in both; but in the latter the escape was only fifteen beats. Widal tests and examination of the excreta for organisms of the enteric group were negative, except for the presence of agglutinins, in the blood, due to prophylactic inoculations.

We did not have the opportunity of inoculating animals with blood collected during the first week of illness, when the virus of typhus is plentiful. A guinea-pig was inoculated with blood drawn from one of the patients on the eleventh day, but the injection was not followed by any febrile reaction.

The epidemiology of typhus in Malaya differs, and differs very widely, from the epidemiology of epidemic typhus as it occurs in Eastern Europe. In the camp at Sungei Besi, infection did not pass from the sick to the healthy. The men slept close together, four in a tent, but no two cases came from the same tent, or even from tents which were next to each other, and none of the medical officers, nurses or orderlies, became infected.

The camp was situated on one side of a valley about 160 feet above sea-level, with slightly rising ground behind it and hills in front. The site was dry and covered with coarse grass known locally as lalang (Imperata cylindrica). It is the principal grazing ground for the cattle of the neighbourhood. Close by the entrance to the camp, from the village road, there were several cattle-sheds and thatched huts occupied by Punjabi bullock-cart drivers. We collected the blood of these men for examination by the Weil-Felix reaction. One of them, who looked very thin and pale, was staying in his house because he was not strong enough to go out with the
cattle. His blood agglutinated B. proteus X 19 in a dilution of 1 in 120, and the examination was repeated on two subsequent occasions with the same result. The man's neighbours told us that he had been ill, though he himself denied it, through fear of being removed to hospital, and it is probable that he had recently recovered from an attack of typhus.

Three days after the camp was removed a Tamil cowherd fell ill with typhus. He lived more than a mile from the site of the camp, but he pastured his own cows in its neighbourhood every day. A few weeks later two Punjabi carters contracted typhus in the same village. They also were accustomed to let their cattle graze about the site of the camp, and they themselves had been employed there with their carts.

A consideration of all these facts shows that they incriminate the waste lalang-covered land where the camp was situated, and the source of the virus which infected the Sungei Besi cases, and the history of patients from other parts of the country corroborates this opinion, for there was the same connexion between waste land and infection in most of them. In this respect the disease resembles the mite-borne tsutsugamushi, especially the Sumatran variety described by Schöffner, and the tick-borne spotted fever of the Rocky Mountains, both of which are associated with uncultivated land. The same peculiarity was noted by Smithson (1910) in the typhus-like fever of the Mossman district of North Queensland and by Megaw in the typhus of the Himalayas.

The aetiology of the disease is obscure, for we are ignorant of the medium through which infection takes place. No lice were found on any of the patients, and it is hard to believe that six men in a camp could be infected with typhus by lice, without passing on the disease to their comrades in a single instance.

Megaw has brought forward evidence which incriminates ticks as carriers of the virus in Himalayan typhus, and possibly the aetiology of the disease in the Malay States can be explained in the same way. The close association of most of the Asiatic patients with cattle, and the fact that the European soldiers had been camping in a place which is used as a grazing ground, are arguments in favour of ticks as vectors of the disease. In places where there are cattle there are usually rats, the site of the military camp is notorious for its rats. Rodents act as reservoirs of the virus in the spotted-fever of the Rocky Mountains; they harbour the larval ticks, while the adult forms are conveyed from one place to another by large animals, such as cattle.

The Malayan disease resembles, in many ways, a typhus-like fever which occurs in Deli, Sumatra, and which is considered by Schöffner (1915), who first described it, to be a variety of tsutsugamushi. According to Schöffner its course can best be described by saying that it corresponds in all respects with that seen in enteric fever. This course, he says, sharply distinguishes it from typhus with its brusque onset and its termination by crisis. There is usually a small ulcer in the groin or axilla, associated with enlargement
of the neighbouring lymphatic glands, and similar to the initial ulcer of tsutsugamushi. This ulcer marks the point of infection and is produced by the bite of a small mite, which is a parasite of the field rat. The ulcer is discernible in all European cases, but it can easily be overlooked in native labourers among the multitude of lesions which are common on their dark skins. The habitat of the mite, Trombicula deliensis, which carries the disease, is uncultivated land. Walch saw over a hundred cases, during 1923, among coolies who had been clearing undergrowth from some abandoned land on a rubber estate in Sumatra. The propinquity of Sumatra to the Malay Peninsula makes it probable that a disease which is common in one country occurs in the other as well, and the question arises: Is the typhus of the Malay States the same as the form of tsutsugamushi which Schüffner described in Sumatra? The correct answer is probably in the negative: firstly, because the primary ulcer and the localized glandular enlargement which are characteristic of the disease described by Schüffner do not occur in the Malayan cases; and secondly, because the Weil-Felix reaction is always positive in the latter. But, apart from tsutsugamushi, tropical typhus probably does occur in Sumatra, and Dr. Vervoort, Director of the Pathological Laboratory at Deli, has recently sent us particulars of some cases of continued fever, without a primary ulcer, which gave a positive Weil-Felix reaction and resembled the Malayan fever very closely if they were not identical with it.

We believe that the disease has a wide distribution in both hemispheres. The most recent report of its occurrence is from the Rio Grande valley of Mexico. Typhus in a severe form, known locally as tarbadillo, has been endemic in the Mexican plateau, at an elevation of some two thousand feet, for hundreds of years, but it was not recognized in the lowlands until last year, when Sinclair and Maxy (1925) investigated a small outbreak of mild typhus in an American cavalry camp on the frontier. Inquiries made among the medical practitioners of the neighbourhood showed that the disease had existed for years in the Rio Grande valley, and some of the doctors had seen hundreds of cases, about two per cent of which were fatal.

The fever was characterized by an abrupt onset, with headache, rigors and vomiting. The temperature reached its highest point during the first week, it became remittent in the second week, and it returned to normal by about the fourteenth day, usually by lysis, but sometimes by crisis. The shortest time in which the fever ran its course was seven days, and the longest was twenty-five days. A typhus-like eruption appeared about the fifth day.

Sinclair and Maxy investigated twenty cases; only three of them were seriously ill and none died. Three of them were slightly delirious, the majority were dull and apathetic. A slight cough was present in all cases. Leucocyte counts were normal. The Weil-Felix reaction was positive. A few guinea-pigs were inoculated, but they failed to show the character-
istic febrile reaction, and they were not immunized against the virus of epidemic typhus.

No two cases occurred in any one house and there was no evidence of direct infection from man to man. No body-lice were found and the authors are inclined to blame head-lice as the vectors, but the American soldiers who contracted the disease harboured none and inquiry showed that many cases had occurred among the better-class inhabitants of the valley who were free from vermin of every kind.

Sinclair and Maxy consider that the typhus of the Rio Grande is the same as the mild form described by Brill, which is endemic in New York under the name of Brill’s disease, and which has been proved to be true typhus by the test of immunity.

The descriptions of these outbreaks in different quarters of the globe are so much alike, and resemble so closely the disease which we call tropical typhus in Malaya, that we believe them to be records of the same disease. We fully expect that the application of the Weil-Felix reaction, with an active standard strain of \textit{B. proteus}, will show that this view is correct, and thus one more disease will be removed from the dwindling group known as the unclassified fevers.

**Records of Cases.**

\textit{Case No. 1, Pte. L.}—This was a severe case. The temperature rose to 105° F. on the eighth day, the patient lay in a muttering delirium for about ten days and the fever was prolonged by broncho-pneumonia. The man, aged 23, was a private soldier. He came from Singapore to the military camp at Sungei Besi, nine miles from Kuala Lumpur, on September 23, 1924. He was taken ill suddenly with shivering and headache on October 9, sixteen days after his arrival at the camp, and was admitted to hospital, in Kuala Lumpur, on the fifth day of illness. A macular eruption, like a syphilitic roseola, was noticed, on the ninth day, over his shoulders and back, but it had disappeared entirely six days later.

His temperature was remittent, being three or four degrees higher in the evening than in the morning. After the fourteenth day it came down to normal, or nearly normal, every morning, but it went up again at night and did not become consistently normal until the twenty-fifth day. The broncho-pneumonia, from which this patient suffered, was probably the cause of the protracted fever.

When we first saw him, on the fifteenth day of his illness, his face had a curious, congested, leaden hue; his conjunctivae were red and his lips were covered with sordes. He was lying in a typhoid state, plucking at the bedclothes and continually muttering in a low, tremulous voice. He appeared to be quite unconscious, but, like a man in alcoholic delirium tremens, he could pull himself together and answer questions. At night his delirium was more active, and many times he tried to get out of his bed. He remained in this state until the twenty-first day and, at one time, the
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Prognosis was so grave that a message was cabled to his friends in England; but he recovered, as we have seen others in a worse case recover from this disease, when there appeared to be little or no hope that they could live.

There was no enlargement of the spleen or lymphatic glands. On the fifteenth day the knee-jerks were present and the hearing was unimpaired, but, four days later, the reflexes were unobtainable and he was noticeably deaf. No lice were found on the patient. Marris’s atropine test was negative on the fifteenth day.

Feces and Urine: Specimens were examined bacteriologically on four occasions, with negative results.

Urine: The diazo-reaction was positive.

Widal reaction: The patient had received prophylactic inoculations in January, 1922, and his blood agglutinated both B. typhosus and B. paratyphosus B, at a titre of 1 in 120, on the tenth, the thirteenth and the fifteenth days.

The Weil-Felix reaction was:

<table>
<thead>
<tr>
<th>Day</th>
<th>Titr.</th>
</tr>
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<tbody>
<tr>
<td>15th</td>
<td>1 in 3,000</td>
</tr>
<tr>
<td>23rd</td>
<td>1 in 6,780</td>
</tr>
<tr>
<td>29th</td>
<td>1 in 1,290</td>
</tr>
<tr>
<td>37th</td>
<td>1 in 480</td>
</tr>
<tr>
<td>42nd</td>
<td>1 in 480</td>
</tr>
</tbody>
</table>

(Under the care of Dr. J. G. Castellain.)

Case No. 2, Pte. B.—This was a mild case in which the temperature did not rise above 101·6° F. The patient was a cook, aged 24, belonging to the Headquarter company of his regiment. He came to the camp at Sungei Besi on September 23, and, according to his own statement, he did not leave it until he was taken to hospital.

His illness began suddenly on October 16, twenty-three days after his arrival, with shivering, headache and pains in the limbs. There was no cough or running of the eyes, nor was there sneezing, epistaxis or vomiting at the onset. He was admitted to hospital on the fourth day of his illness, with a temperature of 100·8° F., which became normal on the twelfth day and did not rise again.

We saw him for the first time on the seventh day of his illness. There were some petechial spots in his axillae and the cervical and axillary glands were enlarged. On the ninth day, his hands, face and tongue were very tremulous, but this passed off in a few days. There was a copious branny desquamation over the chest and abdomen on the fifteenth day.

Urine: The diazo-reaction was negative on the ninth day.

The Weil-Felix reaction was:

<table>
<thead>
<tr>
<th>Day</th>
<th>Titr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7th</td>
<td>1 in 900</td>
</tr>
<tr>
<td>15th</td>
<td>1 in 3,800</td>
</tr>
<tr>
<td>20th</td>
<td>1 in 7,680</td>
</tr>
</tbody>
</table>

(Under the care of Dr. J. G. Castellain.)

Case No. 3, Pte. J.—This man was a private, aged 22, in C company of the same regiment as the last two patients. He arrived in the Sungei Besi
camp on September 23, and was taken ill on October 16, the same day as the last case, twenty-four days after his arrival. He reported sick, with a blotchy rash on his face (which soon disappeared), pains in the knees and drowsiness. He was admitted to hospital, in Kuala Lumpur, on October 20, the fourth day of his illness.

On the seventh day, when we first saw him, his body was thickly covered with a well-marked macular rash of raised, dusky blotches, which were about one centimetre in diameter and fairly close-set, but not confluent. The eruption was general except for the face. There was not very much on the extensor surface of the arms, but it was profuse on the inner aspects. The macules were present on the palms and soles, and there was redness of the fauces. They were thick all over the trunk, and thicker on the chest than on the abdomen. The colour and general appearance of the rash bore a striking resemblance to the macular eruption of secondary syphilis. The rash had faded considerably by the tenth day, but some of the spots had become purpuric, especially those on the thighs. The remains of the rash were still visible as dusky mottling on the abdomen as late as the thirty-third day.

The patient had a remittent temperature, which came down to normal by quick lysis on the thirteenth day. It was never as high as 103° F., and the pulse was never more than 100. The respirations were quickened to thirty-six on the ninth day. Increased frequency of respiration was a noticeable feature in the majority of cases, even in those which had no bronchitis. The spleen was not palpable, but there was a general glandular enlargement. There was no epistaxis and no
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vomiting. The eyes were injected. There was no deafness. The knee-jerks were present on the seventh day, but they had disappeared by the tenth.

Nervous symptoms were prominent. On the seventh day the patient was twitching and tremulous; muttering to himself continually, like a patient in the third week of typhoid fever. By the ninth day he was in a busy delirium, but he could control his attention and answer questions intelligently in a most surprising manner. On the tenth day the temperature dropped suddenly from 102.2° F. down to 99° F.; the delirium left him and there was great change for the better.

A diagnosis of malaria was made at the beginning of this patient’s illness, and he was given quinine. No parasites were found in his blood. There was no history of syphilis. He stated that he had not left the camp while he was at Sungei Besi. No lice or scratch-marks were found on him. Marris’s atropine test was negative on the eighth day, but the escape was only fifteen. The diazo-reaction was negative on the sixth and ninth days.

Urine and faeces: No pathogenic organisms were isolated from specimens collected on the sixth and ninth days.

Widal reaction: The patient had received prophylactic inoculations. His blood agglutinated B. typhosus at 1 in 30 on three occasions. It did not agglutinate B. paratyphosus A, B, C, or Brucella melitensis.

Animal inoculations: A guinea-pig was inoculated with the patient’s blood on the eleventh day, with negative results.

Weil-Felix reaction was:—

<table>
<thead>
<tr>
<th>Day</th>
<th>5th</th>
<th>7th</th>
<th>11th</th>
<th>14th</th>
<th>20th</th>
<th>28th</th>
<th>33rd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td>1 in 60</td>
<td>1 in 240</td>
<td>1 in 400</td>
<td>1 in 1,020</td>
<td>1 in 300</td>
<td>1 in 240;</td>
<td>1 in 240;</td>
</tr>
</tbody>
</table>

(Under the care of Dr. J. G. Castellain.)

Case No. 4, Private C.—This man, aged 25, was a private in a company of the same regiment. He came with an advance party to the camp at Sungei Besi on September 10, and was taken ill suddenly on October 14, thirty-four days later, with a rigor, severe headache and a cough. He was admitted to hospital in Kuala Lumpur on the fifth day of his illness with the diagnosis of bronchitis. His temperature was remittent and swung between 100° F. in the morning and 103° F. at night. It came down by quick lysis and was normal on the thirteenth day.

We saw this man for the first time on the tenth day of his illness. There was no rash, except some sores on the face, body and thighs, which resembled abrasions or tropical pemphigus. They were covered with haemorrhagic crusts and had bled a little on to the bed clothes. He still
William Fletcher

had a cough, but there were no other signs or symptoms. No lice were found on his person.

Blood: The polynuclears formed seventy-eight per cent, and the eosinophils 1·5 per cent of the white cells on the tenth day.

Urine: The diazo-reaction was negative on the tenth day.

Widal reaction: The patient had received prophylactic inoculations, and his blood agglutinated Bacillus typhosus in a dilution of 1 in 60. It did not agglutinate B. paratyphosus A, B, C. Nor did it agglutinate Brucella melitensis.

Weil-Felix reaction was:

<table>
<thead>
<tr>
<th>On the 10th day</th>
<th>1 in 3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>18th</td>
<td>1 in 7,680</td>
</tr>
<tr>
<td>24th</td>
<td>1 in 7,680</td>
</tr>
</tbody>
</table>

(Under the care of Dr. J. G. Castellain.)

Case No. 5, Corporal H.—This man went into camp at Sungei Besi on October 1, and was taken ill with headache and pains in the limbs on October 12. His temperature from that date, until October 24, ranged between 100° F. and 102·5° F. It came down by lysis and was normal on the fifteenth day. Corporal H's attack was the mildest we have seen, and it was peculiar because there was no cough or lachrymation. It began with "awful pains in the eyes and in the head." There was neither vomiting nor epistaxis.

We first saw the patient on the fourteenth day of his illness. His spleen was palpable and there were some brown macules on the abdomen, which were most numerous around the umbilicus. There were no enlarged glands and no lice were found.

Urine: The diazo-reaction was negative on the fourteenth day.

Weil-Felix reaction was:

<table>
<thead>
<tr>
<th>On the 14th day</th>
<th>1 in 480</th>
</tr>
</thead>
<tbody>
<tr>
<td>20th</td>
<td>1 in 3,840</td>
</tr>
<tr>
<td>27th</td>
<td>1 in 1,920</td>
</tr>
</tbody>
</table>

(Under the care of Dr. J. G. Castellain.)

Case No. 6, Lance-Corporal P.—This patient was a lance-corporal, aged 23, in a company of the same regiment. He returned to Singapore, from the camp at Sungei Besi, on October 30, and remained in good health until seven days later, when he was admitted to hospital with fever, headache and an indefinite rash over the abdomen, like prickly heat. The prominent symptoms were meteorism and rapid breathing. The patient's temperature was 104° F. on the eighth and ninth days, and declined by lysis on the thirteenth, fourteenth and fifteenth days. It did not rise above normal after the sixteenth day. His pulse, which was 120 at the height of the fever, was not above 70 after the fifteenth day. The respirations were fifty to the minute on the evening of the twelfth day. We did not see this
patient ourselves and we are indebted to Major D. F. Mackenzie for the notes of the case.

Blood: Leucocytes, 7,000 per cubic millimetre.
Urine and faeces: No organisms of the enteric group were isolated.

Weil-Felix reaction was:—

<table>
<thead>
<tr>
<th>Day</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th</td>
<td>Negative</td>
</tr>
<tr>
<td>18th</td>
<td>1 in 1,250</td>
</tr>
</tbody>
</table>

(Under the care of Major D. F. Mackenzie, D.S.O., R.A.M.C.)

REFERENCES.